

THEOLOGY AND SCIENCE: A NEW COMMITMENT TO DIALOGUE

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IN JUNE 1988 Pope John Paul II made a remarkable statement to participants in an international conference held at the Vatican on the contemporary dialogue between theology and science. He asserted that these two large spheres of human experience and inquiry are interdependent, and that collaborative interaction ought to characterize their present relationship rather than the misunderstandings and conflict so prevalent in their past. "We need each other to be what we must be," the Pope said. "Science can purify religion from error and superstition; religion can purify science from idolatry and false absolutism. Each can draw the other into a wider world, a world in which both can flourish." He envisaged a "relational unity between science and religion," which would result not in identity or assimilation but in dynamic interchange, with each "radically open to the discoveries and insights of the other."

If such intense dialogue does not take place, he warned, then these two institutions will contribute not to the future integration of our common culture but to its fragmentation. Initiative for such dialogue, moreover, must come from the theologians, because historically they have as a group made such little effort to understand the findings of science. Now, however, they must recognize that the

vitality and significance of theology for humanity will in a profound way be reflected in its ability to incorporate these findings. . . . The matter is urgent. Contemporary developments in science challenge theology far more deeply than did the introduction of Aristotle into Western Europe in the thirteenth century. . . . Christians will inevitably assimilate the prevailing ideas about the world, and today these are deeply shaped by science. The only question is whether they will do this critically or unreflectively, with depth and nuance or with a shallowness that debases the Gospel and leaves us ashamed before history.¹

¹ The Pope's message to the conference is in the form of a letter to one of its organizers, George Coyne, and appears at the start of its proceedings: *Physics, Philosophy, and Theology: A Common Quest for Understanding*, ed. Robert J. Russell, William R. Stoeger, and George V. Coyne (Notre Dame: Univ. of Notre Dame, 1988). It appears also in *Origins* 18/23 (Nov. 17, 1988) 375-78. See commentaries by Ernan McMullin, "A Common Quest for Understanding," *America* 160/5 (Feb. 11, 1989) 100-104, and by Michael J. Buckley, "Religion and Science; Paul Davies and John Paul II," *TS* 51 (1990) 310-24. See also *John Paul II on Science and Religion*, ed. Robert J. Russell, William R. Stoeger and George V. Coyne (Notre Dame: Univ. of Notre Dame, 1991).

In spite of appeals such as this, there is general recognition today that it will not be easy to bring about this dialogue. For a number of reasons, theologians do not yet know how to deal theologically with the findings of science. On the other hand, as we shall see, scientists have been having their own problems in recent years regarding collaboration with theologians. In what follows, then, I would like to examine the functioning of these two enterprises, first the professional commitment of scientists, second that of theologians. It will then be easier for us, thirdly, to understand their mutual reluctance today to converse seriously with each other. This understanding will enable us, finally, to evaluate the dialogue itself, such as it is at present, and to ask what opportunities now exist for a more fruitful rapprochement in the future.

It is important to emphasize at the outset that my chief concern in exploring these four large areas is to understand the present possibilities for dialogue. I thus see a need to begin with some historical perspective and then to develop some sense of the obstacles to conversation. What I do not see as necessary at this point is to prescribe some theoretical framework within which to overcome these obstacles. This would take us far too deeply into the philosophy of science, a field that still interests very few scientists and theologians, even though in principle its analyses may be essential as connecting links between scientific and theological data. While mutual agreement on fundamental issues may well be what the dialogue should ultimately aim at, this cannot be its point of departure. For the initial question that puzzles the generality of scientists and theologians, in so far as they are curious about the subject at all, is whether what one group is doing can possibly have any relevance for the pursuits of the other.

Nevertheless, exploring such relevance must inevitably reveal the unspoken assumptions of both parties. Their dialogue cannot, in other words, avoid touching upon many of the theoretical concepts that have long been the province of philosophers of science. Indeed, the two groups may be in a better position to dialogue more effectively today precisely because they have already developed such implicit assumptions. I shall try to point these out as they arise in the course of our discussion, but the particular approach I take to the dialogue, as well as limitations of space, preclude elaboration of these mainly philosophical issues.

THE COMMITMENT OF SCIENCE

Let us begin by recognizing certain common misconceptions about the scientific enterprise. Three very common ones are: that science starts with no presuppositions in its research, that it is based on hard and unimpeachable factual evidence, and that its findings are unalterable and will eventually explain all areas of human experience. In other words,

says this stereotype, the hidden explanatory mechanisms of the world can be discovered through observation by scientists standing apart from the world and theorizing about it objectively. The problem with these misconceptions is not that they are totally false but that they are only partially true. They have been fostered almost unconsciously in the popular mind because all around us we see the extraordinary achievements of science's progeny, technology, achievements that provide for most of our physical needs and for much of our need for entertainment. Hence it is not surprising that scientific attitudes and methods should have become integral to the thinking of most contemporary men and women, many of whom conclude, not unreasonably, that these attitudes and methods are so all-encompassing and reliable as to constitute a sufficient foundation upon which to build their lives.

This conclusion is fostered today by not a few scientists who, sometimes unconsciously, inject its implications into the scientific enterprise as such. A closer examination, however, reveals these convictions to be actually outside the domain of science itself and not required by it at all. They really constitute certain ways of thinking *about* science, an ideology that has come to be known as "scientism," which demotes to the purely subjective all forms of knowledge that fail to deliver prediction and control of what is tangible and concrete. Langdon Gilkey has neatly summarized the two major suppositions of this ideology: first that science represents the *sole* cognitive entrance into reality, and second that scientific knowledge of nature exhaustively defines reality itself, so that what cannot be known by science is simply not there.² Jacob Bronowski's story of the "Ascent of Man" is one example of this scientific triumphalism; Carl Sagan's "Cosmos" is another. Sagan puts it bluntly: "The cosmos—as known by science—is all there is, all there was, and all there will be."³

It is important for us to be clear about the full implications of these ideological assumptions. In their most extreme form they deny to the knowable cosmos all subjectivity, all qualities in any way connected with human emotions and personal experience or with which the human spirit could feel some sense of kinship. All downward causation from the personal to the impersonal is thus eliminated, and everything is explained in terms of the most elementary physical processes. Because the human plays no role in the natural world, no role consequently exists for

² Langdon Gilkey, "Nature, Reality and the Sacred: A Meditation in Science and Religion," *Zygon* 24 (1989) 285.

³ Jacob Bronowski, *The Ascent of Man* (Boston: Little Brown, 1974); Carl Sagan, *Cosmos* (New York: Random House, 1980) 4. An incisive critique of scientific reductionism is given by Arthur Peacocke, *God and the New Biology* (San Francisco: Harper & Row, 1986) 1-20.

purposes, values, ideals or freedom. Hence physicist Gerald Feinberg can refer to life simply as "a disease of matter,"⁴ and psychologist B. F. Skinner can state flatly: "We cannot apply the methods of science to subject matter that is assumed to move about capriciously. . . . The hypothesis that man is not free is essential to the application of scientific method to the study of human behavior."⁵

The saddest implication of all, however, is that if all human activity, precisely as human, is devoid of any meaning, then the discoveries of science, as one of the activities of the human, must share in this meaninglessness. Nobel Prize physicist Steven Weinberg does not shrink from this conclusion: "The more the universe seems comprehensible, the more it also seems pointless. . . . The effort to understand the universe is one of the very few things that lifts human life above the level of farce, and gives it some of the grace of tragedy."⁶ In scientism, then, we have the ultimate manifestation of that imperialistic tendency of science to present itself as the only genuine and exhaustive description of the real. Geneticist Jacques Monod draws the logical conclusion for humankind: "The ancient covenant is in pieces; man at last knows that he is alone in the unfeeling immensity of the universe out of which he emerged only by chance."⁷

In recent years historians of science have begun to question whether this ideology of scientism is really what undergirds the scientific enterprise. Is science as such really so value-free? Is what scientists do really so totally focused on objects, so uninfluenced by personal beliefs and subjectivity? Consider, for example, the massive resistance of the scientific community a few decades ago to the discovery that the universe is expanding at enormous speeds of millions of miles an hour, and that this and other confirmatory evidence indicate that billions of years ago there has to have been some gigantic cosmic explosion that marked the birth of the universe. One physicist trivialized this theory by calling it "the big bang," as if the cosmos were a gigantic firecracker. Einstein was upset simply because the theory implied that the world had a beginning. "The circumstance of an expanding universe is irritating," he wrote in a letter to a fellow physicist. "To admit such possibilities seems senseless to me."⁸ The great British astrophysicist Sir Arthur Eddington complained

⁴ Quoted by Heinz R. Pagels, *The Cosmic Code* (New York: Bantam Books, 1983) 187.

⁵ B. F. Skinner, *Beyond Freedom and Dignity* (New York: Free Press, 1965) 6, 447.

⁶ Steven Weinberg, *The First Three Minutes* (New York: Basic Books, 1977) 154.

⁷ Jacques Monod, *Chance and Necessity* (New York: Knopf, 1971) 180.

⁸ Quoted by Robert Jastrow, "Have Scientists Found God?" *New York Times Magazine*, June 25, 1978, 20. Jastrow was at the time the director of NASA's Goddard Institute for Space Studies.

that "the notion of a beginning is repugnant to me. . . . The expanding universe is repugnant."⁹

The reactions of many astronomers at the time, wrote one astronomer recently, "provide an interesting demonstration of the response of the scientific mind—supposedly a very objective mind—when evidence uncovered by science itself leads to a conflict with the articles of faith in our profession. It turns out that the scientist behaves the way the rest of us do when our beliefs are in conflict with the evidence."¹⁰ The root problem here is that the majority of scientists find it extremely difficult to deal with a natural phenomenon whose causes apparently cannot be explained. Hence the initially strong resistance of many to the discovery that the cosmos very likely did have a beginning, under conditions in which the present laws of physics are not valid and as a product of forces which are as yet unknown. This quasi religious faith in the power to understand is well illustrated by the following assertion of Nobel Prize physicist Sheldon Glashow:

We believe that the world is knowable, that there are simple rules governing the behavior of matter and the evolution of the universe. We affirm that there are external, objective, extrahistorical, socially neutral, external and universal truths and that the assemblage of these truths is what we call physical science. Natural laws can be discovered that are universal, invariable, inviolate, genderless and verifiable. . . . This statement I cannot prove, this statement I cannot justify. This is my faith.¹¹

Beyond these candid remarks of scientists themselves, we should note that philosophers of science have long distinguished between the instrumental success of science (whereby it provides correct expectations about the workings of the natural world) and scientific theories (whereby scientists claim to describe this natural world comprehensively and realistically). The former deals with the value-neutral grounds for nature's control and for successful predictions regarding our natural environment. The latter, in contrast, often tend to conflict with each other, and are frequently undermined by further empirical investigation. The norm for truth of instrumental science would thus seem to be whether or not it corresponds to the physical world of nature. The norm for the truth of a scientific theory, on the other hand, cannot be such empirical correspondence (since multiple theoretical interpretations may fit any given set of accepted facts), but rather whether or not it coheres with the

⁹ Quoted by Jastrow, *ibid.* 24.

¹⁰ *Ibid.* 19.

¹¹ From his paper at a conference on "The End of Science," as reported in the *New York Times*, "Week in Review," October 22, 1989, 18.

total relevant context and achieves consensus among scientists themselves, a process characterized by judgments of value as well as of fact.¹²

This distinction has been the source of a number of contemporary challenges to the presumed impersonal "objectivity" of scientific theories, insofar as these lay claim to the prestige of empirical science. Studies have revealed in striking ways the extent to which seemingly "objective" theories are both culture-dependent and subject-dependent. Science as a whole is now coming to be seen as a far more relativistic project, influenced to a considerable extent by social ideologies and attitudes. Its imperialistic claim to be the single road to certain knowledge has thus been largely eroded, and it is increasingly being viewed as just one of the ways in which humans have sought to make sense of their world. Scientific theories seek answers to practical questions in particular historical circumstances, just like theories in all other areas of human knowing. Often this is done for purposes that are not exclusively scientific, but are also social, moral, political and economic as well.

In his influential 1962 study, *The Structure of Scientific Revolutions*,¹³ Thomas Kuhn, a theoretical physicist turned historian of science, focused on those rare moments when major changes occur in the world views of scientists. These world views he calls "paradigms," clusters of broad suppositions, both conceptual and methodological, which constitute the "received tradition" of a given scientific community and dictate the norms for good science and the direction of research at any particular historical period. Through paradigms scientific communities define and limit the types of question that can be asked as well as the types of solution that are acceptable. During long periods of "normal science" knowledge advances by the application of these key concepts and large methodological assumptions to observed phenomena. But unexpected findings can produce sudden shifts in prevailing paradigms, and these intellectual upheavals have such far-reaching effects that they constitute a scientific revolution. Obvious examples would be the shift from a Ptolemaic model of the universe to a Copernican model, and the displace-

¹² See the two overviews by Mary Hesse, "Cosmology as Myth," in *Cosmology and Theology*, ed. David Tracy and Nicholas Lash (New York: Seabury, 1983) 49-54, and "Retrospect," in *The Sciences and Theology in the Twentieth Century*, ed. Arthur Peacocke (Notre Dame: Univ. of Notre Dame, 1981) 281-91.

¹³ Thomas S. Kuhn, *The Structure of Scientific Revolutions* (2d ed.; Chicago: Univ. of Chicago, 1970). Kuhn's argument has been discussed at length in *Paradigms and Revolutions*, ed. Gary Gutting (Notre Dame: Univ. of Notre Dame, 1980). David L. Hull, another historian of science, has recently proposed a very different biological model: the same kinds of forces responsible for shaping the rise and demise of species also act on the social and conceptual development of science. See his *Science as a Process* (Chicago: Univ. of Chicago, 1988).

ment of Newton's mechanistic model of the interaction of matter and energy by those of relativity and quantum theory.

Kuhn's major point, however, is that there is really very little logical connection between any two paradigms; the choice between them is not dictated by any objective rules. A new paradigm is produced not by data but by intuition, and it then so transforms the imagination of the scientific community that old data come to be seen in a completely new light. Even the meaning of terms changes, as in the switch from Newtonian physics to relativity, in which terms like "time," "mass," and "velocity" came to be understood quite differently. Paradigm shifts are therefore really conversion experiences on the part of scientists. This conversion must occur at once or not at all, says Kuhn, for the simple reason that the paradigms themselves are basically incommensurable and even contradictory. New paradigms explain dimensions of reality that old paradigms do not. Adherence to these new insights is so problematic precisely because their acceptance cannot be forced by logical proofs or neutral experience. Young scientists generally embrace the new paradigm and perpetuate it within their community; the older generation lose the struggle for dominance of the original paradigm, but continue to follow it nonetheless until they eventually die off. For Kuhn, then, paradigm shifts are like political revolutions: they clash with vested interests and they take place outside normal methods of change. In many ways they are, as one critic calls them, the equivalent of "scientific mob rule."¹⁴

Understandably scientists have been reluctant to follow Kuhn in equating science as a social system (within which scientists function under community pressures) with science as a cognitive system (in which data ought to be value-free and governed by logic and experiment).¹⁵ Nevertheless, it is widely accepted today that the two systems cannot be completely separated. The way the scientific community thinks at the time of a paradigm shift, its social goals, and other historical circumstances are not simply superficial manifestations of the change that is taking place but to some limited extent also its cause. This is not to say, however, as Kuhn seems to imply, that the causes of paradigm shifts are neither rational nor objective. Unfortunately it is not always clear, in his critique of these shifts, whether he is referring to the sociology of scientific communities or to the epistemology of scientific discovery. Continuities and overlap are clearly evident between certain paradigms: physicists agree, for example, that Newton's mechanics are the slow-moving equivalent of Einstein's mechanics, and that they still remain

¹⁴ John Polkinghorne, *One World* (Princeton: Princeton Univ., 1986) 13.

¹⁵ Typical of the defensive reactions of scientists to Kuhn's thesis is that of Heinz R. Pagels, *The Dreams of Reason* (New York: Bantam, 1989) 260-64.

valid for systems whose velocities are tiny compared to the velocity of light. Moreover, to hold that all observations are theory-laden, and so subject to social distortion, is not to say that they exert no control at all over theories. For theories themselves are also fact-laden. They must therefore submit to the correctives that come through the continuous testing of objective data in different social contexts over many years, procedures which have always characterized scientific method.¹⁶

Nevertheless, scientists as subjects can no longer be thought of as somehow separated from the objects they study. Their observations, as well as the concepts and models they develop to understand these observations, are interrelated in much more subtle ways than the popular image of science allows. It is therefore not the case that unquestionable experimental facts lead to exact predictions and then to theories that objectively and comprehensively describe the material world. For science is before all else personal knowledge, something going on in persons. The skill of the knower is always present along with the object known. The scientist thus assesses evidence and formulates theories in the same way that a doctor makes a difficult diagnosis, or a judge weighs ambiguous evidence, or a wine taster blends a good sherry. Intellectual beauty, symmetry and simplicity are as operative in these choices as are empirical data. "But just as the sherry blender has to submit the result of his labors to the judgment of the discerning public, so the scientist has to persuade his colleagues of the soundness of his judgment. This necessity saves personal knowledge from degenerating into mere idiosyncrasy."¹⁷

¹⁶ Kuhn's concept of paradigm influence within the scientific community has in recent years been given a much larger societal focus by a movement within the sociology of knowledge known as "the strong program." The myth of scientific neutrality, say these social historians, has made it possible today for government and industry to misuse both pure science and technology to achieve political and economic goals. The questions posed by scientists and the type of answers they seek thus originate, according to "the strong program," not within science but outside it.

As Ian Barbour perceptively notes, however, experimental data are the great corrective to this charge of cultural relativism. While such externalist sociological critiques may be a healthy antidote to internalist views of a purely rational science, they inevitably underestimate the constraints of data upon both outside influence and insider objectives. That is to say, one can justify neither scientific theory nor social ideology without some reproducible confirmatory data. See Barbour, *Religion in an Age of Science* (San Francisco: Harper & Row, 1990) 74-75. Other critiques of "the strong program" will be found in Arthur Peacocke, *Intimations of Reality* (Notre Dame: Univ. of Notre Dame, 1984) 18-22; Martin Rudwick, "Senses of the Natural World and Senses of God: Another Look at the Historical Relation of Science and Religion," in Peacocke, *Sciences and Theology* 241-61; Sal Restivo, "The Myth of the Kuhnian Revolution in the Sociology of Science," in *Sociological Theory* 1983, ed. Randall Collins (San Francisco: Jossey-Bass, 1983) 293-305.

¹⁷ Polkinghorne, *One World* 12. See the more detailed discussion of these analogies by Michael Polanyi, *Personal Knowledge* (Chicago: Univ. of Chicago, 1958).

This socially contextualized and personalistic coefficient in scientific knowledge has prompted many scientists to reconsider how accurately they can know reality, and even whether they have any right to speak about knowing reality at all. The chief catalyst for both reconsiderations has clearly been the discovery of the subatomic world. Long a puzzle to physicists, this world of elusive entities has now become the dominant focus of their thought and experiment. Early in the century Werner Heisenberg formulated his famous uncertainty principle: the more accurately we know about one half of this world (the location of particles) the less we know about the other half (what these particles are doing). While the source of this mysterious indeterminism is not yet known (it could be instrumental, epistemological, or ontological), the knowledge-limitation itself is experimentally certain and its consequence clear: no absolute predictions can be made about the total behavior of anything in the microworld.

Picturability has therefore been lost, and rigid mechanistic causality is now recognized as impossible at this level. None of the entities can be known in itself but only in its relation to the observer. All such observations are thus radically observer-dependent. Niels Bohr once remarked, when a student of his in Copenhagen complained that quantum mechanics made him giddy, "If anybody says he can think about quantum problems *without* getting giddy, that only shows he has not understood the first thing about them."¹⁸ Years later Nobel laureate Richard Feynman made the same admission: "I think it safe to say that no one understands quantum mechanics. Do not keep saying to yourself, if you can possibly avoid it, 'But how can it be like that?' because you will go 'down the drain' into a blind alley from which nobody has yet escaped. Nobody knows how it can be like that."¹⁹

Many scientific positivists would go one step further than Feynman and say that all this talking about entities not accessible to experience is just a conceptual tool to facilitate prediction of phenomena. Such theories are neither true nor false, they say, but simply convenient ways to summarize and harmonize the experimental data available to everyone. What scientists actually see, in other words, are just numbers on computer screens or marks on photographic plates. Besides, how can theories developed from these data possibly represent existing realities, when it is clear that science has changed its mind so often in the past about the basic structure of the universe? When scientists construct models for the subatomic world (i.e. analogies between the behavior of entities on the

¹⁸ Quoted by Timothy Ferris, *Coming of Age in the Milky Way* (New York: Morrow, 1988) 288.

¹⁹ Quoted by Pagels, *Cosmic Code* 13.

macrolevel and the behavior of quantum particles), no one doubts the value of the model for purposes of theory. But why must we presume that the theory represents actual existing particles?²⁰ Here the positivist is not far from the idealist: a theory is simply a mental construct that the scientist imposes upon the chaos of experimental data in order to achieve some modicum of understanding.

These discussions of the relationship of scientific theories to truth and reality have over the last generation moved the scientific community as a whole very far from that naive realism that celebrated a mechanistic view of the world. Today most scientists are more modest in their truth claims about the physical world. Their goal is no longer certain knowledge but only verisimilitude, a slow but progressively more accurate understanding, a gradual tightening of their grip on a reality that they have come to realize will always elude them in its totality. They still seek the truth about nature, but now they are fully aware that what they seek is often selected to accord with their presuppositions and prejudices. "Recognition that science has discovered a wide range of truths is compatible with the conviction that a wide range of truths it has *not* discovered exists, and that its formulations of the truths it *has* discovered are one-sided, presenting only abstractions from the full truth."²¹

Scientists today are thus conscious of the accuracy of the famous parable told by Sir Arthur Eddington in 1929. It concerned a zoologist who decides to study deep-sea life by using a net of ropes on a two-inch mesh. After repeatedly lowering his net and each time studying what he caught, he concludes that there are no deep-sea fish less than two inches in length. Obviously the zoologist's method of fishing determined what he could catch. In the same way, science may still aim at knowing the real, but because it selects only publicly observable sense data, and because its abstract theories about these data are so limited by both culture and subjectivity, it is now no longer possible for scientists to claim that reality is only what they know.²²

To what then are scientists committed in their pursuit of intelligibility? Quite simply to experimentation. It is experimental work that provides the strongest evidence today for scientific realism. For scientists cannot

²⁰ This purely instrumentalist view of scientific theories is defended by Mary Hesse and M. A. Arbib, *The Construction of Reality* (Cambridge: Cambridge Univ., 1981). See also the articles by Hesse (n. 12 above) and Ian Barbour, *Issues in Science and Religion* (New York: Harper Torchbook, 1971) 162-74.

²¹ David Ray Griffin, *The Reenchantment of Science* (Albany: State Univ. of New York, 1988) 9-10. See also Polkinghorne, *One World* 17-25.

²² On this selectivity of science see Barbour, *Issues* 264-66. The parable appears in Arthur Eddington, *The Nature of the Physical World* (Cambridge: Cambridge Univ., 1928) 16.

organize an experiment without believing that its object exists. While their beliefs *about* a particular object may undergo very significant change over time, they cannot even begin to organize any of their observations without asserting the object's existence. This has always been true, even when the object has not been observable. The electron is a good example. Kuhn would say that, when it was first discussed before 1900 in the context of classical physics, it had a meaning and significance radically different from its new status in quantum theory. But physicists today still use the same word to speak of what they presume is the same entity, even though they now remain more open to new ways of understanding its precise nature.²³

Hence the realism scientists assert in practice is about entities, not about concepts, models or theories. The latter tend to be thought of much more frequently as "candidates for reality," with which scientists still aim to unlock the secret structures of nature, but about which they remain always skeptical, without any of those illusions of permanence so confidently claimed by the naive realism of the past. "There is no quicker way for a scientist to bring discredit upon himself and upon his profession," writes the eminent British zoologist Peter Medawar, "than roundly to declare . . . that science knows or soon will know the answers to all questions worth asking, and that questions which do not admit a scientific answer are in some way nonquestions or 'pseudoquestions' that only simpletons ask and only the gullible profess to be able to answer."²⁴

This new "critical realism" is an acknowledgment by scientists that they know reality only imperfectly, and that their search for truth is always influenced by personal judgment. This search is also subject over time to continual public scrutiny, however, and this is what eventually provides the true test of its capacity to cope with new data and predict

²³ Kuhn, *Structure* 198–204. Unlike Kuhn, the philosopher Karl Popper insists on the importance of experimentation as a means of logically and deductively refuting scientific hypotheses. General laws and theories themselves, however, are not inductively derived from such observation, but rather have their origin in the imagination and intuition of the scientist. As such they can never be positively verified, but only shown by data to be false. There can thus be no absolute certainty in any scientific theory; the most we can expect is a gradual approximation to truth. Popper's understanding of science is to be found in his many books, including *The Logic of Scientific Discovery* (New York: Basic Books 1959) and *Conjectures and Refutations* (London: Routledge & Kegan Paul, 1963). It should be noted that many philosophers of science would not agree with Popper that for a theory or principle to count as "scientific" it must conceivably be able to be proved wrong.

²⁴ Peter Medawar, *Advice to a Young Scientist* (New York: Harper & Row, 1979) 31. Quoted by Polkinghorne, *One World* 61. The "candidates for reality" phrase was coined by Rom Harré and used often in his writings, e.g. in *The Philosophies of Science* (New York: Oxford Univ. 1972) 93; *Theories and Things* (New York: Sheed & Ward, 1981) 22. See Peacocke, *Intimations* 22–34.

new phenomena. In other words, by criticizing competing theories we can steadily approximate objective truth. It is precisely this rational staying power of the scientific enterprise that finally yields genuine verisimilitude. Models and theories may indeed only approximate the real world, but with each new approximation science's grip on this world is tightened ever so slightly. For science is a way of thought, not merely a body of knowledge, and scientists now readily admit that the way they think has its own built-in limitation. Such contemporary modesty in truth claims has also had an unexpected result: many scientists in recent years have begun to listen with more respect to other truth claims about the real world, especially to those proposed by the insights of contemporary theology.

THE COMMITMENT OF THEOLOGY

When we turn now to the professional commitment of theologians, it is important to distinguish at the outset between religious faith experience and the intellectual reflection upon that experience which is the theologian's concern. "Faith seeking understanding" is the classic definition of theology. Hence the presupposition of the theological enterprise is that there is an identifiable sphere of human interaction with reality which results in a sense of the Absolute that transcends sense perception. In the case of Christians this is the central religious experience of God's self-disclosure through the revelatory events of the Bible. This initiative of God reconciled them, they believe, to God's own self, to others and to themselves, through the life, death and resurrection of Jesus of Nazareth, who lived on the Jewish periphery of the Roman empire some two thousand years ago. In the person of Jesus they find the fullness of God and the decisive key to the meaning of human existence. This union with God in Jesus is mediated for them historically through the Christian Scriptures and through the teachings and sacramental rituals of the Christian faith community.

Christian theologians thus have a threefold data base on which to rest their intellectual analysis: the biblical narratives as testimony of the earliest witnesses to God's self-revelation, the tradition and worship of the Christian churches over the centuries, and the contemporary experience and life commitment of believing Christians. Theological analysis then seeks to explore, often with the aid of secular disciplines, the cognitive aspects of this total faith experience, which obviously includes other important aspects, such as those that are historical, social, liturgical, and institutional. The starting point is the fact that, from biblical times to the present, the Christian community has never doubted that it

is truly in touch with a transcendent dimension of reality, that it encounters God living and operating here and now in the lives of its members. This type of experience is not limited to Christians, of course. William James concluded his seminal work on religious psychology at the turn of the century with an affirmation of its universal character; and Rudolph Otto's classic study of the "numinous" element in all religion shows it to be everywhere an awareness of mystery, majesty and fascination.²⁵

But what the theologian wants to know is the extent to which this experiential component, involving as it does existential decision and a total commitment of one's life, can indeed be captured in concepts and propositions. When will such cognitive formulations be more than purely subjective preference or personal taste? In what sense can they be said to communicate objective truth for the knower? For even though religious language normally functions in the contexts of worship and life-orientation, it nevertheless contains assertions about *what* one worships and to *what* one is oriented.²⁶ These assertions may not be verifiable experimentally, but religious people still believe that they have an objective reference, and that reasons can be advanced for holding them to be true. Thus the theological task of understanding and evaluating these cognitive claims of religion cannot be avoided.

Theological interpretation of biblical texts has had a checkered history. Premodern theology was certainly not hermeneutically naive in dealing with this first data base. Interpretative categories had long existed in the allegorical exegesis of Origen, Augustine, and Aquinas. In the religious turmoil of the 16th and 17th centuries, however, rigidity and authoritarianism was the order of the day for both Protestants and Catholics, and as a result biblical literalism generally prevailed. This was exemplified most blatantly in the public condemnation of Galileo in 1633. While knowledgeable people at the time were well aware of the deficiencies of geocentrism and attracted to the heliocentric theory of Copernicus, the Catholic Church had a special problem. For this geocentric cosmology had come to be identified with religious orthodoxy: it was part of that Aristotelian world view within which all medieval theology had been constructed, and it was supported by a literal reading of biblical texts dealing with the heavens. Thus Galileo's repeated public proclamation that he had proved Copernican theory to be a fact (which even his

²⁵ William James, *The Varieties of Religious Experience* (New York: Collier, 1961); Rudolph Otto, *The Idea of the Holy* (New York: Oxford Univ., 1958).

²⁶ For an extensive discussion of the inevitable tension involved between the existential commitment of religious experience and the theologian's task of understanding and evaluating religious belief claims, see Barbour, *Issues* 207-69.

supporters acknowledged he had not) appeared to be a threat to orthodoxy that had to be publicly eliminated.²⁷

Such an authoritarian approach to biblical texts eventually had to face the stringency of the Enlightenment critique which took into account the autonomy of human reason. This proved to be a watershed that changed the whole direction of biblical hermeneutics, since until then theologians had assumed that religious faith always had to act as reason's guide. Tools of language and textual criticism were now taken much more seriously, and by the end of the 19th century, when the discovery of evolution seemed once again to contradict the Christian scriptures, biblical scholars were able to offer Church authorities more constructive ways to deal with the challenge than were available in the time of Galileo.

While biblical literalism still flourishes today among fundamentalist Christians, mainly as a source of certainty in a time of moral relativism and rapid cultural change, Roman Catholicism has abandoned it, as well as all mainline Protestant churches. For the scholarly analysis of scriptural texts has shown that the biblical writers believed themselves to be recording not infallible divine dictation, but rather events in their lives which they experienced as revelatory of God's presence, as in the history of Israel, for example, or in the person of Jesus. Hence most Christian theologians no longer think of their Scriptures as the ahistorical revelation of God, but as a divine revelation mediated by time and circumstance, whose meaning develops in the course of history. The biblical witness must inevitably be partial and limited, experienced and reported by fallible witnesses, as well as influenced by the thought forms of a particular historical period. Because there is no such thing as uninterpreted experience, there can therefore be no such thing in the Bible as an uninterpreted revelation of God.²⁸

²⁷ In 1984 the Vatican formally acknowledged the error of this condemnation. See *Origins* 16 (1986) 122. Galileo's undoing was his insistence that he had proven heliocentrism beyond doubt and that church authorities must immediately reinterpret all biblical texts to the contrary. But the evidence he produced (the orbits of the moons of Jupiter and the waxing and waning of Venus, both seen with his telescope) was quite inconclusive at the time, and this gave his enemies on the papal commission their excuse for humiliating him: he was forced to abjure heliocentrism publicly and live under house arrest until his death.

Given Galileo's enormous contribution to science, recognized even in his lifetime, this episode in the history of theology and of the Church is both sad and fascinating, and its literature is very extensive. The best of the longer studies is Giorgio de Santillana, *The Crime of Galileo* (Chicago: Univ. of Chicago, 1955). An excellent short account is William R. Shea, "Galileo and the Church," in *God and Nature*, ed. David C. Lindberg and Donald L. Numbers (Berkeley: Univ. of California, 1986) 114-35. There is also the interesting theory regarding the true motivation behind Galileo's condemnation advanced by Pietro Redondi, *Galileo: Heretic* (Princeton: Princeton Univ., 1987).

²⁸ Barbour discusses this change in theological thinking in regard to scripture in *Issues* 60-62; 96-105; 229-237.

Just as Christian theology became progressively more open and tentative in regard to its understanding of Scripture, its first data base, so it also developed new attitudes toward its second base, the formal doctrinal teachings of the living Christian tradition. Protestantism and Roman Catholicism followed very different paths, however, in reaching such new understandings. Liberal Protestant theologians of the nineteenth century, led by Friedrich Schleiermacher, initially sought ways to formulate traditional Christian doctrines in light of the then current concerns of scripture scholars for the human character of the biblical record. But their efforts gradually led them to deemphasize the revelatory character of the Bible altogether, and to derive their theological reflection on Christian faith primarily from an interpretation of religious experience. To this was added a strong reliance on philosophical reflection and ethical consciousness as important sources for our knowledge of God. But such increased emphasis on the human as an object of inquiry inevitably meant that there would be less and less place for Scripture and church tradition.

The neoorthodoxy of Karl Barth reacted strongly against this liberal Protestant neglect of historical revelation. Only God's self-disclosure, insisted Barth, not the human search for God, can be the starting point for theology. Christians must therefore recognize a radical discontinuity between God and God's revelation on the one hand, and human reason and culture on the other. God is totally transcendent to human persons, and this gap cannot be bridged from the human side, but only through God's coming in Jesus Christ. This insistence on the primacy of revelation, moreover, went hand in hand with a general acceptance by Barth of the results of critical biblical scholarship, which convinced him that the Bible speaks only of human creatureliness, sinfulness and dependence on God, and says nothing at all about nature or cosmology or human cultural achievement. The human person, as the present receiver and interpreter of revelation, was consequently ignored and the capacity of reason correspondingly devalued. Human experience at particular points in history had relatively little importance; revelatory events of the past alone had true religious significance.²⁹

Neoorthodoxy provoked its own reaction. The movement known as Christian existentialism put exclusive emphasis on contemporary experience and individual self-understanding: God can be encountered only in the immediacy of a personal relationship. The most influential of these theological existentialists, Rudolf Bultmann, insisted that to speak of God's activity as if it were somehow objective in historical events, as the Bible seems to do, is mythological. None of the events grounding traditional Christian teaching were really observable; they were all inte-

²⁹ On neoorthodoxy, see Barbour, *Issues* 116–119, 229–32, 376–80.

rior events of rebirth and transformation of the heart. The question to be asked by theology, therefore, is how this mythical imagery of Scripture can be translated into language about one's own existential situation and about new possibilities for one's life here and now. The Christian message, in other words, refers not to objective happenings in the past but exclusively to new understandings of ourselves and to a present transformation of our lives. These God accomplishes in us in the midst of the hope, despair, fear, and decision of our historical existence.³⁰

Obviously the problem with Christian existentialism is not its concern for the personal lives and experiences of Christians, since these phenomena form the third data base on which contemporary theology rests its intellectual analysis. The problem is rather that existentialism as a theological approach totally privatizes Christianity, separating it from its historical community structures as well as from its belief that its traditional doctrines, however interpreted, are truth claims about objective realities. This is not to say that the religious practices of Christians cannot be understood as a way of life, or a set of attitudes and strategies for moral living, since this is obviously the way Christians speak about them. What constitutes the existentialist position, however, is a reliance on these experiences and practices that tends often to ignore the key historical role of doctrinal truth, the confession of which has always been central to Christian life.

Unlike Protestantism, Roman Catholicism dealt in a much more authoritative fashion with the implications of modern biblical criticism for traditional doctrinal teaching. Until the end of the nineteenth century the study of the Bible had relatively low status in Catholic intellectual circles. But, as Catholic scholars gradually sought to acclimatize church teachings to the modern world, they began to use the same historical-critical methods as liberal Protestants in their search for a scientifically sound approach to Scripture. The reaction of Pius X to these intellectual efforts was repressive and harsh, less because of any particular doctrinal formulations (almost all of which are commonplace today) than because he perceived an implicit threat to church authority in the attempt to make scientific study the arbiter of religious truth. In 1907 he labeled all the efforts of these widely diverse scholars "Modernism" and condemned the movement *en bloc* as heresy.

Hence in the Roman Catholic Church there was never any specifically theological response to the so-called "Modernist" crisis comparable to the neoorthodox reaction to liberal Protestantism. The response was rather one of pure disciplinary authority, motivated by a need for submission, theological uniformity, and institutional stability. By 1910 the

³⁰ Ibid. 119-121, 431-37.

nascent Catholic intellectual elite was silenced, and all free theological inquiry and innovation effectively suppressed. A certain fundamentalist mentality now took over, ecclesiastical as well as biblical. It was not until 1943 that Catholic scholars were at last allowed to apply scientific methods to the study of Scripture, and not until the Second Vatican Council in the 1960s that official Catholic theology finally internalized the problems of modernity and responded to the "Modernist" challenge with genuinely theological argument.³¹

As we come to the end of the twentieth century, then, Protestantism has provided some badly needed correctives for Catholicism's rationalizing tendency, which usually overdeveloped the importance of neat propositional statements. Nevertheless, because theology's perennial thrust is for intelligibility, the issues of revelation and truth will not go away. The question theologians are now faced with, consequently, whether they be Protestant or Catholic, is how precisely to deal with these issues in the future. Obviously the first step is to be aware of the limitations of one's conceptual tools. Only fundamentalist Christians repudiate such limitations today. We have already noted some of these limitations as they have affected our understanding of the biblical texts. Let us see now how these conceptual tools are further restricted by the inevitable need of theology to employ models and paradigms.

Theologians have come to recognize in recent years that their language is much less scientific and much more metaphorical than previously realized, as well as much richer in those systematic and relatively permanent metaphors called models. The awareness of Arthur Peacocke is typical: "The model of God as personal, transcendent Creator, immanent in and transforming his creation and especially man, i.e., of God as Creator, Redeemer, Sanctifier, is a root-metaphor which has a comprehensive role at the summit of a hierarchy of theological models and metaphors explicating religious experience."³² Though less conceptually precise than doctrines, religious models have always had a strong affective function, evoking moral and spiritual response, commitment and self-involvement, especially in Christian liturgy. Thus God is referred to as Father, Mother, Creator, Shepherd, Judge; Jesus as Christ, Son of God, King, Savior; the Holy Spirit as Comforter and Advocate. Even abstract religious concepts like "transcendent" and "immanent" contain a spatial metaphor.

³¹ For a brief overview of Modernism see the perceptive treatment by Roger Haight, "The Crisis of Modernism," *Compass* 8 (1990) 21-24. Two studies by Alec Vidler will provide fuller background and analysis: *A Variety of Catholic Modernists* (London: Cambridge Univ., 1970) and *The Church in an Age of Revolution* (London: Penguin, 1971).

³² Peacocke, *Intimations* 43.

Nevertheless, this Christian faith experience of God's self-disclosure and personal relationship to us in Jesus clearly contains beliefs *about* God and *about* the relationship. These beliefs *in* inevitably involve statements *that*. While truly cognitive, these theological statements are not explicitly descriptive, however, because the reality of God is simply beyond the capacity of language to express. As the parables of Jesus suggest, we are able to speak of God only by analogy. This is because the religious encounter is so open: there is no way to specify in advance or to control the experience. Because meaning is to be found exclusively in the event itself, it can be captured only by symbol. Such cognition must always be partial and inadequate, and yet it is precisely this gap between symbol and referent that gives the theologian room for maneuver in making propositional statements.³³ All words used in such statements must therefore inevitably fall short of the concepts they signify.

If this limitation on religious language is so clear to theologians today, what have they to offer in defense of the claim that such language actually catches reality? Are religious models just useful fictions, whose only function is to express and evoke a certain psychological attitude or ethical response? The answer would seem to lie in the crucial distinction between referring to God and describing God. A critical realism would say that a model comes into existence originally in order to help an individual or community to interpret an event or experience by imagining what cannot be observed. Subsequently linguistic communities and interpretative traditions perpetuate the model, thereby guaranteeing a continuity of reference and protecting the model against arbitrariness and distortion. Hence there is, as Ian Barbour notes, a genuine intersubjective testing among members of any given religious community. "The interpretation of initiating events, formative experiences, and subsequent individual and communal experiences goes through a long process of testing, filtering, and public validation in the history of the community. Some experiences recur and are accepted as normative, others are reinterpreted, ignored or discounted."³⁴ The more recurrent and widespread the experiences in question, the more secure the reference and hence the reality.

However, such intersubjective testing has its limitations. Janet Soskice makes the point well: "To be a realist about the referent is to be a

³³ See the keen analysis by Janet Soskice, *Metaphor and Religious Language* (Oxford: Oxford Univ., 1985) summarized in her "Knowledge and Experience in Science and Religion: Can We Be Realists?" in Russell, Stoeger, and Coyne, eds., *Physics, Philosophy, and Theology* 174-83. Polkinghorne, *One World* 26-42, also deals trenchantly with this question.

³⁴ Ian Barbour, *Religion* 88. Barbour relies on the analysis of Soskice as well as his own extensive treatment in *Myths, Models and Paradigms* (New York: Harper & Row, 1974).

fallibilist about knowledge of the referent. . . . So the theist may be mistaken in his beliefs *about* the source and cause of all, . . . for fixing a referent does not on this account guarantee that the referent meets a particular description."³⁵ Christian theology, in other words, tends too easily to forget that there is an "is not" in all metaphor. The confident personal witness and affirmation of God's self-revelation, therefore, does not mean that the reflective understanding and verbal expression of this knowledge can be anything more than approximate. These theological formulations, moreover, because they are to a large extent critical reflections on the life and thought of Christians at a particular time, will always be revisable, subject to a process of testing by the community. Nor is such revision a negative factor in the search for intelligibility. "Rational argument in theology," says Ian Barbour, "is not a single sequence of ideas, like a chain that is as weak as its weakest link. Instead, it is woven of many strands, like a cable many times stronger than its strongest strand."³⁶

Not only is theological discourse limited by the use of models, however; it is also limited because, just like scientific discourse, it must take place within a certain paradigm, a certain broad set of metaphysical and methodological assumptions. Hans Küng has helped to show how Kuhn's analysis of historic changes in the world views of science can be applied also to theology.³⁷ Like "normal science," "normal theology" is generally conservative. Traditional questions and modes of thought are passed on by particular theological communities; young theologians are initiated into these community practices and do their theological work in the context of community expectations. Before a paradigm change actually

³⁵ Soskice, *Metaphor* 217. Quoted by Peacocke, *Intimations* 45, who also relies on the work of Sally McFague, *Metaphorical Theology: Models of God in Religious Language* (Philadelphia: Fortress, 1982).

³⁶ Barbour, *Religion* 90. A recent statement by the Vatican's International Theological Commission has cautiously endorsed this need to reinterpret doctrinal statements in a contemporary context: "The definition of a dogma, therefore, is never just the end of a development, but always a new beginning as well . . . Such a contemporary interpretation of dogmas must take into account . . . the abiding validity of the truth and the actuality of the truth. . . . Consequently the work of theology, the historical study of the sources as well as dialogue with sciences dealing with humanity and its various cultures, with hermeneutics, linguistics and philosophy are of great importance for the contemporary interpretation of dogma. . . . Without doubt the permanent and valid content of the dogmas is to be distinguished from the way in which they are formulated. In any age the mystery of Christ surpasses the possibilities of formulation and thus eludes any final systematization" ("On the Interpretation of Dogmas," *Origins* 20 [1990] 12).

³⁷ Hans Küng, "Paradigm Change in Theology and Science," in *Theology For the Third Millennium* (New York: Doubleday, 1988) 123-69. See Barbour's discussion of Küng in *Religion* 56-58.

takes place there is a transitional period of uncertainty, during which normal theology gets challenged, usually provoking strong reaction and resistance to whatever might alter the status quo. The growing crisis finally peaks, and eventually a sudden breakthrough takes place for a new interpretative framework.

Küng lists five major paradigm changes in the history of Christian theology: from the apocalyptic paradigm of primitive Christianity to the Hellenistic paradigm of the patristic period, and from there to the Augustinian paradigm, the medieval Thomistic paradigm, the Reformation Protestant and the Counter-Reformation Catholic paradigms, and finally to the critical Enlightenment paradigm. This latter is presently being challenged by a contemporary ecumenical paradigm, according to Küng, the full dimensions and implications of which are not yet known. Representatives of various traditional theologies, moreover, still cling to and work within older paradigms: Orthodox within the Hellenistic paradigm, fundamentalist Protestants within the Reformation paradigm, Roman Catholics within the Counter-Reformation paradigm, and liberal Protestants within the Enlightenment paradigm. Because each of these paradigms arose in a specific time of crisis and uncertainty (such as the rise of science during the Enlightenment), a long period of normal work and cumulative growth inevitably followed once the crisis had passed, in which the scope of the paradigm was extended and all major changes resisted.

Küng takes pains to emphasize that in the course of each of these paradigm shifts there is a root conceptual stability in the midst of comprehensive conceptual change, a continuity in the midst of discontinuity. For the effort is always to reformulate the original tradition, not to rediscover it: to communicate a fresh experience of the original biblical message of God's self-revelation in Jesus. Within whatever paradigm it takes place, therefore, Christian theology is always an effort to think through what is believed to be the truth of the Christian faith. What is distinctive about the present theological crisis is that so many cultural factors are also involved: secularization, religious pluralism, racism, sexism, the turmoil of developing nations, the ambiguity of science and technology, environmental problems, and the threat of nuclear war. The experiences of women and of the Third World of being exploited, for example, have been contributing for some time now to the correction of many endemic biases in the classical theological tradition.³⁸

³⁸ See the papers of the many contributors to the symposium on *Paradigm Change in Theology*, ed. Hans Küng and David Tracy (New York: Crossroad, 1989), especially Anne E. Carr, "Feminist Theology in a New Paradigm" 397-407, and Leonardo Boff, "The Contribution of Liberation Theology to a New Paradigm" 408-23.

We have been discussing models and paradigm shifts in theology because we are trying better to understand the contemporary commitment of theologians to articulate the Christian faith experience. This commitment is worlds apart from the popular stereotype of theologians as closed-minded ideologues rigidly defending propositional statements which they expect all Christians to follow without question. For all these conceptualizations of God's revelation in Christ are now recognized as no less "candidates for reality" than the theories and models of science. All earlier theological models, based on historical and authoritarian understandings of beliefs, have by and large collapsed today, except in the minds of biblical or ecclesiastical fundamentalists. Naive realism has yielded to a sense of the complexity and tentative character of most theological issues, and all easy solutions risk looking like so many efforts to preserve the status quo. Theological understandings are coming rather to be seen as time-bound efforts to translate a historical message from the world of past experience to the world of the present. In short, theologians have as a group been experiencing for some time now a genuine modesty in regard to both what they know and how they know it. Their enterprise of understanding reality has therefore turned out to be as corrigible as that of science.³⁹

OBSTACLES TO CONVERSATION

In these commitments of science and theology can be seen, I think, the two major contemporary efforts to grapple with and rationally to

³⁹ What I have described as the professional commitment of Christian theologians is how the vast majority go about practicing their craft today. The inverse of this approach has been developing for some time, however, in such nontheological areas as the history, sociology and philosophy of religion. The former outlook assumes that religious language is the product of a distinctive historical experience of God and of one's relationship to God, whose primary and normative source for the Christian is the biblical narrative, expressed and communicated in more or less adequate ways by metaphors, symbols, and models. The latter outlook assumes that language is rather the producer of this experience, which in turn is its effect, not its cause. When applied to Christian doctrines, this alternative model says that their most important function is their use as rules of discourse and action. All authoritative Christian teaching is therefore to be regarded simply as rule theory.

George Lindbeck believes that this "cultural-linguistic" view of doctrine is better than what he calls the "experiential-expressivist" view, because it does not ghettoize theology by isolating it from close association with the best of nontheological thinking. He concedes, however, that "experiential-expressivism" may be better suited to the religious needs of modernity and is in fact the model habitually used by the generality of Christian theologians. He would also have to acknowledge, I think, that doctrines never appear in the tradition as no more than ways of speaking about certain Christian attitudes and practices. See his *The Nature of Doctrine: Religion and Theology in a Postliberal Age* (Philadelphia: Westminster, 1984).

organize the human experience of reality. Although concerned with radically different subject matter (revelation in history has no parallel in science), the ultimate quest of each is for intelligibility rather than for the generation of observable data. Alfred North Whitehead, philosopher as well as mathematician, saw this relationship clearly: "The dogmas of religion are the attempts to formulate in precise terms the truths disclosed to the religious experience of mankind. In exactly the same way the dogmas of physical science are the attempts to formulate in precise terms the truths discovered by the sense perceptions of mankind."⁴⁰ A skeptical and qualified realism, moreover, has become the working assumption of by far the majority of scientists and theologians. The epistemology of science differs from that of theology, but, as we have seen, a common sociology of knowledge, arising from the dynamics of history and culture, can both critique and illumine the efforts of each.⁴¹

It would seem, then, that dialogue between these two intellectual enterprises should not only be possible but even welcomed. What proves to be intelligible in their observations is applied by science to prediction and control of nature, and by theology to questions of life's ultimate meaning, to the worship of God, and to personal responsibility. Hence theology tends naturally to use more "actor" language, science more "spectator" language. (As we saw, however, science has a much more human face than the popular stereotype allows.) The interaction of the two should consequently reveal a certain complementarity rather than conflict. For both are concerned with nature and the cosmos, the one as lawful structure, the other as related to God and to humankind. One

⁴⁰ Alfred North Whitehead, *Religion in the Making* (New York: New American Library, 1974) 57. Arthur Peacocke calls this unusual relationship "the two books," and gives one of its best summaries in *Creation and the World of Science* (Oxford: Clarendon, 1979) 1-38.

⁴¹ This contemporary critical realism thus asserts that we can know to some extent the truth about real objects, but clearly departs from traditional Western foundationalism by denying that our perception and inference can give us absolute certitude. This is because both scientists and theologians have come to recognize, each through their own distinctive experience of reality, that too many cultural, personal, and conceptual filters intervene between the knowing subject and the object known.

One could legitimately argue, of course, that the current crisis in both theological and scientific knowledge is more extensive and radical than I have indicated. Whether or not this is actually the case would not affect the main points I am making, namely that scientists and theologians generally aim at some intelligibility of the real, and that the truth claims of each are now far more modest and tentative than they were in the past. For an overview of developments that today raise questions about this search for intelligibility see, on the science side, James Gleick, *Chaos* (New York: Penguin, 1987), and Ilya Prigogine and Isabelle Stengers, *Order Out of Chaos* (New York: Bantam, 1984); on the theology side, David Tracy, *Plurality and Ambiguity* (San Francisco: Harper & Row, 1987), and Mark C. Taylor, *Deconstructing Theology* (New York: Crossroad, 1982).

would think that theology ought to be attentive to all discoveries of nature's structure, and that science ought to be open to hear with respect whatever theology has to say about relating these discoveries to the larger and more complex area of religious experience. We should expect, in other words, some fruitful exchange along the lines suggested by John Paul II.

Yet it is only with extreme reluctance that scientists and theologians can get themselves to speak with each other today, and it is important for us to understand why. Let us begin with theology. There is a certain legacy from the past here that is difficult to overcome, occasioned by the transition in the West from a medieval mentality to the modern critical mentality engendered by the Renaissance and solidified by the Enlightenment. The Christian churches generally resisted this transition, and finally adapted to it only after the new methodologies of philosophy and the natural sciences gained sufficient status and prestige. In the meantime, church authorities often overstepped the boundaries of theology to make pronouncements on questions that were answerable only in scientific terms and about which they totally lacked competence. Religious resistance to the heliocentric system of Copernicus thus lasted a long time, as did religious insistence that the evolution of living beings could not be true because it contradicted the account of creation in Genesis. Biological emergence of humans from animals was denied for over a century, and as late as 1950 the Catholic Church was still insisting officially that all humans originated from a numerically single pair. In the words of Karl Rahner:

The Church has often shown too little understanding toward those branches of anthropology in which the material, biological reality of the human being as such is validated. The Church's relation to genetics, to depth psychology, to the development of the social life and morals of humankind as conditioned by natural science was never especially benevolent, was not sufficiently differentiated. The Church was always quicker to say no than to say yes.⁴²

Religious leaders on local, national and international levels are much more prudent and tactful today in what they say about science. This strategy enables them in effect to ignore scientific findings altogether, or to minimize their significance in relation to what they see as the overarching importance of human values. They justify such unconcern because Christian faith is addressed to the average person, and the work of scientists is usually inaccessible to this average consciousness. The fact that science has so often in the past played a surgical role in regard to

⁴² Karl Rahner, "Science and Theology," in *Theological Investigations* 21 (New York: Crossroad, 1988) 25.

deep-rooted religious beliefs is additionally a reason for distrust.⁴³ Science's cold light has thus always been seen as a threat. There is little recognition, for example, that Darwin's corrective to the biblical narrative of creation was indeed healthy for religion, releasing the early chapters of Genesis to function powerfully as the biblical authors clearly intended, namely as a story of the goodness of all creation as the work of a free and transcendent God, and of human dependence upon and alienation from God as the source of life.

Ironically, a new and healthy development in contemporary theology is having a further negative effect on this dialogue. This is the deprivation effected by political and liberation movements acutely conscious of massive global suffering. These movements are eager to assuage such suffering with all the theological resources of the Christian tradition, and their sensitivity understandably has little interest in the religious implications of scientific discovery. Because theologians in these movements are reacting strongly against the existentialist disregard for the needs of human community, they naturally tend to regard all cosmological issues as distractions from Christian responsibility for the poor and oppressed. Indeed, one of their claims is that science as an enterprise serves mostly rich nations, with only a tiny percentage of its research aimed at problems typical of poor countries. This has naturally led them to emphasize the liberating message of the doctrine of redemption and to neglect any exploration of the doctrine of creation. Theologians sympathetic with both these movements are therefore seeking today to modify what they see as an overemphasis on society and history. They want to reintroduce into consideration the important third category of "world" or "cosmos," and to insist that human salvation cannot be divorced from that of the material universe, which Scripture says is also "groaning in pain."⁴⁴

A final factor inhibiting the dialogue is awareness of the perennial danger of theology seeking to incorporate even the best science of the day, whose findings have truly become part of the intellectual culture of a particular period. This is, after all, what happened in the Middle Ages, when biblical theology was so merged with the cosmology of Ptolemy and Aristotle that it was impossible for the Church to respond flexibly when this cosmology was finally discredited. The great fear of those who argue this way is that attaching one's religious belief to contemporary science is a sure route to obsolescence: married to science today, a widow tomorrow, as Arthur Peacocke would say.

But there is a false supposition here, namely that the only objective

⁴³ Polkinghorne, *One World* 65, makes this point well.

⁴⁴ See the critique by Tracy and Lash, *Cosmology and Theology* 88-89. The biblical text referred to here is Rom 8:22.

theologians could possibly have in this dialogue would be to gain some new evidence to validate a particular traditional teaching. Such an aim would not be theological at all, however, and would really constitute a neglect of revelation and religious experience as the true supports of the teaching in favor of certain scientific data that would allegedly provide stronger support. If theologians were really to have this objective they would simply be looking for some new "God of the gaps" type of argument, like the classic example in which a creator God is invoked as a hypothesis to account for those puzzling aspects of the natural world that science for the present at least is unable to explain.⁴⁵ If, on the other hand, the true objective of theologians is to seek in science not new evidence for their teachings but rather new insight into them, then their search for the intelligibility of faith experience would in no way be compromised by dialogue. They would simply be recognizing that some features of our natural world have become so well established that it would be foolish for the theologian not to take them into account.

This reluctance of theologians to dialogue with scientists, which we have been discussing up to now, is matched today by an equal reluctance on the part of scientists. The reason is quite simply that in the eyes of scientists religion constitutes a threat—not to themselves personally so much as to the integrity of their method, which seeks knowledge of universal causality. This will come as a surprise only to those whose image of science is still governed by the conventional stereotype: scientists as detached collectors of observable data, validating their theories by clear-cut criteria, and testing them against indisputable factual evi-

⁴⁵ In a widely publicized allocution to the Pontifical Academy of Sciences in 1951, Pius XII appealed to the Big Bang model to confirm what he called the "classical proofs" for the existence of God and for a finite beginning of the universe in a divine act of creation. As was to be expected, scientists were generally upset by this misunderstanding and misuse of their theory for apologetic purposes. But many Catholic philosophers and theologians were equally disturbed, because they could find no direct connection between scientific statements about cosmic beginnings and biblical statements about the creative power of God. See *The Proofs for the Existence of God in the Light of Modern Natural Science: Address of Pope Pius XII to the Pontifical Academy of Sciences* (Washington: National Catholic Welfare Conference, 1952).

A more balanced epistemological evaluation is that of Ernan McMullin, "How Should Cosmology Relate to Theology?" in Peacocke, *Sciences and Theology* 39: "What one could readily say, however, is that if the universe began in time through the act of a Creator, from our vantage point it would look something like the Big Bang that cosmologists are now talking about. What one cannot say is, first, that the Christian doctrine of creation 'supports' the Big Bang model, or, second, that the Big Bang model 'supports' the Christian doctrine of creation." Finally, it is important to recognize that this doctrine is not a teaching about cosmological beginnings in time at all, but rather about the absolute dependence of everything on God at every moment; nor do biblical scholars believe that the Genesis story refers literally to such beginnings.

dence. But this stereotype ignores the impact of their methodology on the personal lives of scientists, and attributes to them a confidence in their intellectual pursuit which, as we saw earlier, has been severely limited in recent years, and in some areas even eroded.

Consider, for example, this reaction of Albert Einstein, when faced with the full implications of the discovery that the universe was expanding at fantastic speeds: "It was as if the ground had been pulled out from under one, with no firm foundation to be seen anywhere, upon which one could have built." Or that of Wolfgang Pauli in the months before Heisenberg formulated a new theory of quantum mechanics: "At the moment physics is again terribly confused. In any case, it is too difficult for me, and I wish I had been a movie comedian or something of the sort and had never heard of physics."⁴⁶ In principle, however, this collapse of earlier mechanistic and positivist models served to free scientists to sense the ultimate mystery of reality, and as a result some actually became more open to religious insight. Werner Heisenberg, for example, could write: "Although I am convinced that scientific truth is unassailable in its own field, I never found it possible to dismiss the content of religious thinking. . . . Thus in the course of my life I have repeatedly been compelled to ponder on the relationship of these two regions of thought."⁴⁷

But this greater openness to religion in the personal lives of scientists is only with the greatest difficulty translated into their professional lives where dialogue with theology must take place. Princeton sociologist Robert Wuthnow, after analyzing a number of recent studies of science vis-à-vis religion, concludes that the irreligiosity of most scientists is a "boundary posturing mechanism" to maintain the precarious reality of the work they do. That is to say,

irreligiosity helps to maintain the plausibility of the scientific province by differentiating scientists (in their own minds) from the larger public who represent everyday reality and generally maintain stronger religious identifications. By helping to maintain the plausibility of the scientific role for the scientist, irreligiosity contributes to his or her role performance as a scientist, as indicated by higher productivity and greater attachment to the values of science. . . . [In short,] the more successfully scientists can extricate themselves from the realm of everyday reality, of which conventional religion is an important aspect, . . . the more likely they are to make the transition successfully into the scientific role.⁴⁸

⁴⁶ Quoted by Kuhn, *Structure* 83-84.

⁴⁷ Werner Heisenberg, "Scientific and Religious Truths," in *Quantum Questions*, ed. Ken Wilber (Boston: Shambhala, 1984) 39.

⁴⁸ Robert Wuthnow, "Science and the Sacred" in *The Sacred in a Secular Age*, ed. Phillip E. Hammond (Berkeley: Univ. of California, 1985) 196-97.

In the mind of the average scientist, therefore, his or her work needs to be protected not from religion so much as from everyday life in which religion flourishes. The other phenomenon noted by Wuthnow is that "scientists seem more likely to *think of themselves* as religious persons than they are actually to engage in any of the conventional practices or beliefs associated with religion." This fact "suggests that scientists may be able to maintain private, nonconventional religious orientations at the same time that their public boundary-posturing activity calls on them to disidentify with the conventional religious performances that are tainted by everyday reality." Wuthnow concludes that

the proverbial conflict between religion and science may be more a function of the precariousness of science than of the precariousness of religion. Rather than religion being constantly on the run, so to speak, in the face of ever advancing scientific knowledge, scientists have had to carve out a space in which to work by dissociating themselves from the powerful claims which religion has had traditionally, and which it still appears to command over the everyday life of contemporary society.⁴⁹

The religious beliefs and values of many scientists may thus appear to them to be perfectly valid forms of personal faith, as long as this faith is isolated from religious practice and closed to scientific scrutiny. They are content to live in two equally legitimate but separated realms, between which there can properly be neither conflict nor compromise. Werner Heisenberg, whose words on religious commitment we quoted earlier, could be quite explicit:

The care to be taken in keeping the two languages, religious and scientific, apart from one another, should also include an *avoidance of any weakening of their content by blending them*. The correctness of tested scientific results cannot rationally be cast in doubt by religious thinking, and conversely, the ethical demands stemming from the heart of religious thinking ought not to be weakened by all too rational arguments from the field of science.⁵⁰

This explains, of course, why most scientists feel so ill at ease in dialogue situations with theologians. They are suited neither by training nor by disposition to grapple with the larger questions that tend to arise in these discussions, such as those that touch on the history and philosophy of science, as well as the relation of science to society, to ethics, or to the history of religious thought. On the other hand, most theologians, as we saw, are equally ill at ease, because as a group they find great

⁴⁹ Ibid. 198-99.

⁵⁰ Heisenberg, "Scientific and Religious Truths" 43. Italics in original.

difficulty with the language of science. Their humanistic training hardly prepares them to appreciate or to work with the rigorous insistence by scientists on the importance of empirical, causal, and testable data. "God," says one scientist, "is in the details of existence. And anyone who refuses to look there is likely to be worshiping idols."⁵¹

Hence some significant effort is needed on both sides to overcome the pull to isolation that arises naturally from the historical experiences of each, as well as from their present methodologies and psychological concerns. The motivation to do this from the theological side has to come from the realization that, if God is in fact the all-encompassing reality Christian faith proclaims, then what science says about nature, whether physical, chemical, or biological, can never be irrelevant to a deeper experience of God. The language of science, moreover, is now the common possession of humanity as a whole, and not to use this language in understanding and communicating Christian teaching entails a serious risk of not being heard. Science, for its part, must recognize the religious quest as one of the major and permanent realities of human life, even in our present technological culture. Not to relate to this quest in any way at all is simply to impoverish science. Langdon Gilkey makes this point well:

A scientific community that ignores the relation of its truth and its life to law, to morals, and to fundamental religious symbols... only makes itself and its culture vulnerable to ideological capitulation. Ignorance of the religious in both its demonic and its creative forms can be even more fatal for a scientific culture than ignorance of new scientific and technological developments.⁵²

It is important for all parties involved to recognize, moreover, that dialogue will tend to be strongly resisted by movements within Christianity that we mentioned earlier: fundamentalism (whether biblical or ecclesiastical), neoorthodoxy, and Christian existentialism. Though very different in many respects, each seeks to isolate theology by insisting that what is distinctive and constitutive of Christianity, namely revelation and commitment to a way of life, is totally absent from science. By supposition, therefore, we have two realms with no common interests or points of contact, and hence no possibility of communication. Between theological assertions and scientific assertions there can only be total separation. Impersonal nature is thus either of no religious importance or is important merely as the physical setting chosen by God for human redemption. Nor is it any accident that theologians in these movements

⁵¹ Pagels, *Dreams of Reason* 312.

⁵² Langdon Gilkey, "The Creationist Issue: A Theologian's View," in Tracy and Lash, *Cosmology and Theology* 68.

tend to endorse positivism as the correct description of the scientific enterprise: such a view helps them emphasize the dichotomy all the more, since positivism asserts that sense data are the only reliable norm for knowledge, and that any religious statements which cannot be verified by such data must therefore be meaningless.

Nevertheless, there is a fundamental truth in these negative assessments of dialogue and it should be freely acknowledged: some language problem is inevitable in all discussions between theologians and scientists. A certain discrimination will be especially needed on the part of theologians in dealing with the extrascientific statements of scientists, and on the part of scientists in dealing with extratheological statements of theologians. The neuralgic issue is thus not the existence of such a language problem but its severity and the extent to which it can be resolved. In our earlier discussion of scientific and theological commitments we saw the many similarities as well as the key differences in these two approaches to knowledge: each intends to speak of reality (though for each the data and content of this reality are quite different), and each in recent years has become more tentative and modest in regard to what it actually knows. Science also appears to be less objective in its methodology than was previously thought, theology to be less subjective. Propositional statements in both languages are thus seen to be approximations of objective truth, as "candidates for reality," always open to modification and correction from new data, as well as from more accurate concepts, models and theories. In spite of their mutual reluctance to dialogue, therefore, theologians and scientists are more ready today than in the past to show genuine respect for each other's truth claims.

But there will obviously be different ways for them to conceive the relationship between their respective languages, and some provisional agreement on this relationship ought perhaps to constitute an early goal of their interaction. How in practice might one language serve to illumine the other? Superficially one could say that science asks "how" questions about observable sense data, and religion asks "why" questions about personal goals and ultimate purpose. Such a distinction is too easily blurred, however, since scientists obviously profess faith in the intelligibility of nature and have their own ultimate concerns in the pursuit of truth, and theologians are often curious to know how the world God created actually works.⁵³ This overlap of interest need pose no serious

⁵³ Langdon Gilkey pressed this "why/how" distinction during his testimony against the creation scientists in their trial at Little Rock in 1981. The trial concerned an Arkansas law mandating the teaching of creation science in public schools if these schools taught evolution. Gilkey's strategy, which succeeded, was to defeat the arguments of biblical literalists, who through creation-science courses sought to propagate scientific conclusions

epistemological or methodological problem as long as theological language and concepts are not used to answer strictly scientific questions and vice versa.

Ian Barbour proposes the category of "levels" of knowledge as a way to relate the two languages.⁵⁴ This is a methodological concept that is common in science, where levels of analysis are relative both to the state of knowledge at the time and to the problem under investigation. Scientists use different abstract models and theories because they believe that there are different levels to be analyzed in the objective structure of the world. This structure in turn reveals levels of organic complexity in nature that chemistry and physics do not deal with, and in the case of humans there occur events of reflective intelligence whose complexity biology does not deal with. However, none of this implies that there exist separate strata or sharp boundaries in nature, and so these levels of activity, like levels of analysis and organization, are not seen to be mutually exclusive.

Hence the presence of distinctively higher-level phenomena in humans does not rule out in their case the laws of physics, chemistry and molecular biology. When the language of theology makes assertions about humans as persons addressed by God, therefore, this likewise does not exclude any scientific statements regarding lower-level phenomena like atoms, neurons, and DNA molecules. There is, in other words, a continuous spectrum of levels in the total human unit, and these need to be addressed by language appropriate to the particular level in question. The reason all these languages, whether scientific or theological, ought to be able to communicate with each other is precisely their reference to this objective reality and unity of human beings, to which both science and theology bear witness.

Holmes Rolston deals with this language problem from another point of view, by emphasizing the fact that science and theology do not confront each other as closed but as open systems. The issue is thus not whether they are compatible as systems, but whether their different emphases do not simply reflect a common effort to render the universe and human beings as fully intelligible as possible. Science is mainly in search of physical causes, theology mainly in search of meanings and values. Tension exists between them at the points of their overlap because we

derived from the Genesis story. See his account of the court proceedings in *Creationism on Trial* (San Francisco: Harper & Row, 1985). Gilkey himself holds a far more subtle understanding of the relationship (ibid. 161-208). For a discussion of the other court cases involved in this controversy, see my *Boundaries Dimly Perceived: Law, Religion, Education, and the Common Good* (Notre Dame: Univ. of Notre Dame, 1990) 89-92.

⁵⁴ Barbour, *Issues*, 335-37, 359-64.

all want our understandings of causes and meanings to cohere. "The warfare between science and theology is often a struggle to clarify to what extent causal explanations are compatible with or antagonistic to meaning explanations."⁵⁵

Sometimes "precursors of meaning" may even appear in biological and sociological explanations, but a religious explanation is usually needed to provide a full account of meaning. Nor do such full accounts of meaning compete with causes. Rather there is a "causal looseness" in matter itself, an unfinished openness and indeterminacy well documented by science. It is here that meanings are to be found, not in some "perforation of the natural by a supernatural order." Indeed, notes Rolston, warrants exist within the sciences for nonreductive causal explanations that allow for the influence and effectiveness of purpose. For the universe that science studies is not a mere sequence but a story, a struggle upward through matter, life, thought, history, and culture. Only a narrative can really capture what is going on. And it is precisely this need of humans for meaningful narrative that allows theology to complement the causality of science.

OPPORTUNITIES FOR THE FUTURE

Once their mutual reluctance is overcome and commitment made to achieve some mutual understandings, it is incumbent on both parties to be realistic about the dialogue. Hence we must now ask, finally, what objectives we can expect to achieve through this collaborative interaction between scientists and theologians. I believe that only one focus will make the conversation worthwhile for the two participants, at least initially, and that is the human person. There is, of course, a second focus of supreme importance today, namely the responsibility of human freedom for the use of science's progeny, technology. But this focus raises so many large and delicate questions of morality that it demands the

⁵⁵ Holmes Rolston, III, *Science and Religion: A Critical Survey* (New York: Random House, 1987) 25. See also pages 22–26, 179–86, 219–24, 278–82, 311–17, 326–36. It is important to note that the concept of physical causality is not the same in classical and contemporary world views. Before 1900 the natural world was regarded as mechanically determined and in principle totally predictable. Today indeterminacy is recognized at the microlevel and, because of the complexity of causal chains, unpredictability at the macrolevel. This causal uncertainty is compounded in the megaworld of intergalactic distances and cosmological processes unfolding over billions of years. While the scientific ideal still remains the discovery of causal dependency, there is now much more use of and reliance upon the tool of correlation between physical situations, which may or may not yield a causal connection. This tool will obviously be more central in some areas, such as biology and medicine, where physical causes are so much more difficult to determine. See Peacocke, *Creation and the World of Science* 52–63.

participation and expertise of many thinkers from many fields in addition to those from the natural sciences and theology. Hence we shall touch briefly on this second focus only insofar as it is derivative of the first and a manifestation of the mysterious power of human freedom.

Only in recent years have scientists begun paying any attention at all to human beings. The sheer complexity of the human tended in the past to be totally overlooked. The sophisticated tools of relativity theory and quantum mechanics enabled physics to move with ease from the enormously simple and relatively empty structures of galaxies to the simple and equally empty structures of the subatomic world. Physicists never paused in this movement to notice the incredible intricacy of the human phenomenon midway between the immense and the infinitesimal. Biology and chemistry dealt with the molecular and genetic structures of living things, but, because reflective consciousness was restricted to the higher forms of life, there seemed to be good reason to regard it as a mere epiphenomenon of life. Human persons, each with more atoms in their make-up than stars in the universe, were thus relegated to just another animal species.

This situation is now slowly changing. A new science has emerged that challenges traditional science because of the order of being that it studies: that range of the very complex that exists between the range of the infinitely large and the infinitely small. Physicist Heinz Pagels recently explained this development:

Science has explored the microcosmos and the macrocosmos; we have a good sense of the lay of the land. The great unexplored frontier is complexity. Complex systems include the body and its organs, especially the brain, the economy, population and evolutionary systems. . . . Scientists, in a new interdisciplinary effort, have begun to meet the challenge of complex systems and, remarkably, are understanding how complexity can emerge from simplicity. . . . Some aspects of our moral behavior—behavior that either reflects or constitutes our moral values—seem extremely complex, but conceivably they arise from simple elements that can be understood. While science cannot judge, it can help us understand.⁵⁶

Pagels believes that this new orientation of science is the first step toward a resolution of the apparently unresolvable conflict between the reductionist and the transcendental views of reality. For the first, life and even human culture is nothing but complex chemical reactions; for the second, human thinking so transcends the material world that the cultural matrix of art, religion and science form an invisible universe of meaning. "The mind, it seems, is transcendent to nature. Yet according to the material sciences that transcendent realm must be materially

⁵⁶ Pagels, *Dreams of Reason* 12, 329.

supported and as such is subject to natural laws. Resolving this conflict is, and will remain, a primary intellectual challenge to our civilization for the next several centuries." Like many scientists, Pagels holds both views to be true, and does not want the conflict resolved by collapsing the differences in some simplistic way in favor of one or the other. But he does not want permanent dualism either, and he looks to the new concern of science for complexity as an eventual way out. "Where these new developments are headed no one can tell. But they portend a new synthesis of science that will overturn our traditional way of organizing reality."⁵⁷

While science is coming to see the unusual character and significance of complex systems, theology, absorbed as it must be with the self-transcendence of human persons, is being forced by science to see these hearers of God's word in their true physical insignificance in the cosmos. We know today that the human species is one of about two and one-half million known species, a relatively recent arrival in the cosmos, living on a medium-sized planet orbiting an average star in the outer regions of an ordinary spiral galaxy, that has about a hundred billion other stars in it, and that exists in a universe with at least a billion other galaxies. Alpha Centauri, the nearest star to our sun in our Milky Way galaxy, is four light years away, which is the distance light travels in four years at the rate of 186,272 miles per second, or about 23 trillion miles. The traditional Christian message that humans are the ones for whom the material world primarily exists, when delivered in this context of overwhelming vastness, is not easily heard.

It is far more likely, as Karl Rahner has said, that Christians who think about these things will begin to feel themselves to be an accidental, marginal phenomenon, a chance product of a very localized evolutionary process that is itself known to abound in countless improbable accidents. They will then find even more dizzying the teaching that the eternal God who holds these billion galaxies in place actually became human on this tiny speck of planet. For most people the narrow horizon of everyday life will usually serve to neutralize this dizziness, but Rahner believes that Christians simply have to start getting used to this feeling of being lost in the cosmos. In other words, they must find a way to allow the scientific view of the world to coexist in their consciousness with the Christian view, without minimizing either their own cosmic insignificance or their importance and dignity as human persons. Indeed,

their very *recognition* and *acceptance* of the fact of being lost in the cosmos actually raises them above it and enables them to realize it as an expression and

⁵⁷ Ibid. 12-13.

a mediation of that ultimate experience of contingency which they, in virtue of their ancient faith, must perceive and accept before the infinite God as finite creatures. . . . In this way the feeling of cosmic dizziness can be understood as an element in the development of people's theological consciousness. . . . If people have to give up their feeling of being at home in the universe in exchange for the feeling of not being at home, which reflects the character of their religious experience, then this is at root a legitimate element of humankind's fate.⁵⁸

Because of this physical insignificance of the human, and also because of the old scientific fiction of a totally objective observation, scientists usually do not notice the fact that the operation of their own minds is the most sophisticated and complex thing the material world has yet produced. In charting the size of the universe or the depths of the atom or the organic mechanisms of life, scientists are exercising powers of thought that are really the products of matter, in so far as it has at last come to know itself and to be capable of reflecting upon its world. Scientists who claim they can never find any signs of spirit among the objects they investigate fail to notice why this must be so. The reason, notes Langdon Gilkey, is that what they are investigating are all *objects*, lacking any inwardness and often existing in the past. The scientists themselves, as present knowing subjects doing the actual investigating, are simply left out. And so, if Carl Sagan is referring only to the exteriority of nature when he insists that the cosmos is all there is, he is clearly wrong: there is also Carl Sagan looking at the cosmos and trying to make sense of it.⁵⁹ Holmes Rolston makes this same point: the most significant thing in the known universe is immediately behind the eyes of the observer.

In our three pounds of brain there may be more operational organization than in the whole of the Andromeda galaxy. The number of possible associations among the trillion neurons of a human brain, where each cell can "talk" to as many as a thousand other cells, may exceed the number of atoms in the universe. The number of possible genetic combinations in the offspring that a man and woman can conceive may exceed the number of atoms in the universe.⁶⁰

Hence it is reasonable to expect that serious dialogue over time between scientists and theologians must eventually produce changes in how the human phenomenon is regarded. Already science has begun to recognize that, in the world of nature, more seems mysteriously to come from less: the universe is somehow right for the production of thought and freedom, which have come into being from what billions of years ago was originally

⁵⁸ Rahner, "Science and Theology" 50.

⁵⁹ Gilkey, "Nature, Reality and the Sacred" 294.

⁶⁰ Rolston, *Science and Religion* 66.

matter strewn out into the universe by exploding stars. How is it that such a lifeless and mindless cosmic process should have accomplished this almost infinitely improbable feat? And how is it that physical reality is somehow adapted to our mode of knowing and so can be understood by us as observers? This baffling intelligibility inherent in the universe has struck more than one scientist with awe. "The most incomprehensible thing about the universe," Einstein once said, "is that it is comprehensible."⁶¹ Is there not here at least a hint of some transcendence, an intimation of a wider reality than science has elected to investigate, a realization that science raises questions that its own methodology does not allow it to answer? Max Planck, the father of modern quantum theory, knew this well: "Science cannot solve the ultimate mystery of nature. And it is because in the last analysis we ourselves are part of the mystery we are trying to solve."⁶²

If scientists should now be more willing than in the past to see their models of reality as partial, applicable only to certain restricted levels of reality, theologians should be no less willing to see their own models in the same way. For they can no longer pretend to understand the fullness of human history and cultural change apart from the dynamics of a physical nature and a cosmic process some fifteen billion years old. If in dialogue they are eager to say what Christian faith can contribute to the understanding of this process, they must also be ready to listen when scientists point to the theological impact of certain realities in the natural world. Because there is no reason to doubt that the human future will be any less the product of scientific discovery and research than the human past, there is also no reason to doubt that theology will continue to feel the effects of this influence. Traditionally theologians have been interested in persons primarily as social and historical beings, and this is why they are currently directing much of their energy to strategies for political and social reform. But this focus needs to be complemented now by that of the scientists, who are interested in persons primarily as *natural* beings. These scientists are just as much concerned with the human future as are the theologians, but their proposals must necessarily be in the context of the human relationships to matter and to its movement.

This mention of proposals for the future brings us now to the issue of human freedom in the dialogue. The immediate objective ought not be to discuss very complex ethical questions involving the uses of technology, but simply to acknowledge that science as well as theology must carry a

⁶¹ Quoted by Ferris, *Coming of Age* 385, from *Einstein: A Centenary Volume*, ed. A. P. French (Cambridge, Mass: Harvard Univ., 1979) 53.

⁶² Quoted by John D. Barrow and Frank J. Tipler, *The Anthropic Cosmological Principle* (New York: Oxford Univ., 1986) 123.

burden of responsibility. This will not be as easy as one might expect, since not all scientists would agree that they have any role to play in this context. Some would say with Albert Einstein that "science can only ascertain what *is*, but not what *should be*, and outside of its domain value judgments of all kinds remain necessary. Religion, on the other hand, deals only with evaluation of human thought and action; it cannot justifiably speak of facts and relationships between facts."⁶³ While science as such obviously cannot resolve moral conflict, scientists themselves have to recognize that what they pursue in their research can reach dangerously beyond their immediate objectives. Theologians therefore have every right to insist that scientists recognize the full significance of free decision in their work. For their freedom inevitably involves them in something more than natural science, and that something is all too often freighted with social dilemmas and moral ambiguity.

This focus on the human person, which I believe to be the key to the dialogue's success, must eventually involve the two parties in some discussion of the relationship of matter to spirit insofar as this is to be seen in human beings. Such discussion must aim first of all at making the positions of each discussant intelligible to the other. Scientists will have the easier task here because, insofar as they think of the question at all, they will tend either toward dualism if they believe in God or toward materialism if they do not. The dualist, following Descartes and Newton, will think of mind and body as radically distinct, the extended material body functioning like any other machine, only inhabited by a "soul" as the principle of human subjectivity. In the current biological context these scientists would have an insurmountable difficulty explaining how a totally spiritual source of consciousness could have evolved from matter, just as Descartes and Newton in their day had no explanation of how the soul interacts with the body it inhabits (the "ghost in the machine" as Gilbert Ryle called it). Hence in the former case as in the latter, the creative intervention of God must fill the gap.

Most scientists, however, are materialists. They avoid the conceptual problems of mind/body dualism by equating mind with the brain. For these reductionists all interior consciousness, all mental states, are nothing but physical states of the central nervous system. While we do indeed have a conscious experience that we know directly, this experience exerts no causal power on the physical world; it is simply a concomitant of certain physical processes which are causally related to other physical processes. We are still machines, therefore, but now we have no "ghost." Geneticist Jacques Monod puts it succinctly: "Anything can be reduced to simple, obvious mechanical interactions. The cell is a machine. The

⁶³ Albert Einstein, "Science and Religion," in Wilber, *Quantum Questions* 108.

animal is a machine. Man is a machine.”⁶⁴ Such scientific materialism has its own problems, of course. Why should humans have such a thing as self-conscious experience in the first place? Why should such interior experience have developed at all in an evolutionary process if it had no biological function? How could it have been selected if it was irrelevant to survival?

Theologians, for their part, have in the past always held some version of spirit/matter dualism, in their case in order to articulate the transcendental character of human persons, their unlimited openness to hear and respond to God's self-disclosure. The traditional name for this higher spiritual dimension of the human came from the Greek concept of "soul," which by its very nature had to be distinct from the body to which it was joined. In this dualism matter was usually undervalued as the physical matrix for the "soul," which was alone seen as the depository of divine revelation as well as the instrument and direct object of salvation. By the turn of the century, when the discovery of evolution became impossible to deny, theologians usually reacted by saying that, while one might have to speak of the evolution of the human body, the spiritual and transcendent character of the human soul demanded a special creative intervention of God. In other words, there was another gap that had to be filled, this time at the moment of conception.

With our present knowledge of evolutionary theory and of genetics, however, theologians have become aware that they cannot draw any easy boundary between matter and spirit. Clearly there is no such dichotomy in the Bible: for biblical authors humans are psychosomatic unities. The body as a prison from which death liberates the soul is a Greek not a Hebrew idea. On the side of matter, what has helped theology is the full retrieval of Christian teaching on the resurrection and immortality of body and soul together. Matter can thus be taken more seriously when its future spiritual destiny is acknowledged. On the side of spirit, theologians eventually learned that evolutionary theory itself recognized a self-transcendence of the lower into the higher, of the less continually producing the unexpected and unpredictable more. This meant that body/soul dualism is no longer the only way to safeguard the irreducible

⁶⁴Quoted by Barbour, *Religion* 6. See also 196–97. We are focusing here, it should be noted, on the corporeal aspects of the human person which we find combined with the extraordinary capacity for reflective consciousness. This approach to "matter" is able to provide an immediate common ground for scientists and theologians. Very few at this early stage in the dialogue will want to get involved in the more abstract philosophical question of some commonly agreed meaning for "matter." Theologians generally do not find this to be a pressing theological problem, and scientists as a group will have very different experimental experiences of "matter," depending on whether they are astrophysicists, particle physicists, physical chemists, or molecular biologists.

spiritual principle in human persons. The theological focus has finally shifted, therefore, to the potential spirituality present in the actual dynamisms of matter, and to a new understanding of God's continuous creative presence and causality within the process of physical evolution. When in the ordinary course of this process *homo sapiens* appeared on the scene, an altogether different relationship developed between God and nature, for something radically new was now possible, a species that could consciously respond to a God who was personally present in knowledge and love to all members of the species.⁶⁵

No one has done more to help theologians hammer out this middle position between dualism and materialism than Pierre Teilhard de Chardin. By profession a geologist and paleontologist, Teilhard faced earlier than most religious thinkers the full implications of evolution for understanding the relationship of matter and spirit. When he spoke to scientists he emphasized that the transition from life to thought was an example of what is common in nature: "In every domain, when anything exceeds a certain measurement, it suddenly changes its aspect, condition or nature. . . . Critical points have been reached, rungs in the ladder, involving a change of state—jumps of all sorts *in the course* of development." Exteriorly this movement of life involves the slow development of the nervous system and brain, but this increase in complexity corresponds experimentally to a slow interior growth of consciousness. Indeed, said Teilhard, "the story of life is no more than a movement of consciousness veiled by morphology." Like the temperature of boiling water, this psychic temperature in the cellular world was inevitably transformed at a single stroke, leaping across the threshold of reflection to thought, "a mutation from zero to everything." This interval, however, is "transexperimental, about which scientifically we can say nothing."⁶⁶

⁶⁵ Rahner, "Science and Theology" 27–31, 41–46; Gabriel Daly, *Creation and Redemption* (Wilmington, Del.: Glazier, 1989) 49–55. Rahner and Daly note that one can still refer to this process, if one so wishes, as "the special creation of the human soul," because they both want to give a benign interpretation to the words of Pius XII in his 1950 encyclical *Humani generis*: "The Catholic faith obliges us to hold that souls are immediately created by God" (DS 3896). Rahner insists, however, that the ancient teaching tradition of the Christian Church on the origin of the human soul did not in fact hold this clearly. Hence the Pope could have meant only "to emphasize that the transcendentality of the human subject cannot be derived simply from its material presuppositions with their material foundations, since one must still make a distinction between body and soul (even if it is now more difficult than before to affirm their unity and diversity ontologically)" ("Science" 44). Daly merely remarks that "this teaching was never defined and there is no intrinsically compelling reason for holding that it is an indispensable model for treating human creation" (*Creation* 52).

⁶⁶ Pierre Teilhard de Chardin, *The Phenomenon of Man* (New York: Harper Torchbook, 1965) 78, 168, 171, 172.

To theologians, on the other hand, Teilhard spoke in a different vein:

Need I repeat that I confine myself here to phenomena, i.e. to the experimental relations between consciousness and complexity, without prejudging the deeper causes which govern the whole issue? In virtue of the limitations imposed on our sensory knowledge by the play of the temporo-spacial series, it is only, it seems, *under the appearances* of a critical point that we can grasp experimentally the "hominizing" (spiritualizing) steps to reflection. But with that said, there is nothing to prevent the thinker who adopts a spiritual interpretation from positing (for reasons of a higher order and at a later stage of his dialectic), *under the phenomenal veil* of a revolutionary transformation, whatever "creative" operation or "special intervention" he likes.⁶⁷

CONCLUSION

Let me summarize the main argument I have been making and draw two brief conclusions. The present dialogue between scientists and theologians is at best in its infancy: neither group, as a group, is well prepared to understand the sources, methods or subject matter of the other. While there are ample historical reasons for this, as well as for the current reluctance to change it, the thought processes of each group have nevertheless undergone a remarkably similar development in recent decades. They have both become more modest regarding the certainty of what they know as well as more open to outside influences. Their epistemologies may differ because of the different types of human experience they investigate, but there is a common sociology of knowledge available to both, and this goes far toward explaining their common commitment to the intelligibility of reality as well as their growing respect for each other. Hence new opportunities do exist for dialogue today, especially if the participants limit their initial focus to what each can contribute to new insights into the human.

The first conclusion we can draw is that theologians are in a position to gain more from this dialogue, at least initially, than are scientists. This is undoubtedly why John Paul II directed his message primarily to them. For their neglect of physical nature, of all those forces present in the cosmos and in life, has been almost total. *That* God creates all that exists has usually been their only concern. *What* and precisely *how* God creates has been of little or no interest. Only within a dialogue process, therefore, is it possible for them to learn anything about the fantastic

⁶⁷ Ibid. 169, n. 1. We cannot do more here than to indicate the two main emphases of Teilhard. For a fuller understanding see the chapter on "The Birth of Thought" (ibid 163–190) as well as "The Analysis of Life," in his *Activation of Energy* (New York: Harcourt Brace Jovanovich, 1971) 129–39.

results of God's creative power, and the implications of these results for human persons and their relationship to God.

Such an experience cannot but affect the way theologians think about nature itself as a source of knowledge about God, creation, divine providence, and the mystery of evil. They must also begin to ask about the relation of such "natural theology" to the "theology of nature" long derived from biblical revelation, which emphasizes God's immanence in the world as well as transcendence to it. The source references in these pages are an indication of how extensive this questioning has already become. Outside the context of dialogue, moreover, new theological efforts must certainly be made to reformulate certain traditional Christian doctrines in the context of widely accepted scientific findings regarding the evolution of matter and the human person. Christology, original sin, redemption, the theology of death, and the material character of the afterlife are the most obvious areas raising new questions which theologians must somehow confront.⁶⁸

Secondly, we must recognize that scientists will be interested in discussing their findings with theologians only in so far as theologians are willing to meet them on their own ground. For few scientists, even among those who are religiously committed and who readily acknowledge their models to be partial, are much interested in strictly theological questions. The most that can be expected, as we saw, is respect for the integrity of the theological enterprise as a search for its own particular intelligibility of human experience. This means that the focus of the dialogue proper must be on the scientific understanding of nature and the human person, and on what we can and cannot know about God from these findings. To quote Whitehead once more: "When we consider what religion is for mankind, and what science is, it is no exaggeration to say that the future course of history depends upon the decision of this generation as to the relations between them."⁶⁹

Because their primary orientations are so different, as well as their tools of intelligibility, any concerns which are seen as common to both science and theology can never be pursued without friction or without

⁶⁸ The literature in this area of doctrinal reformulation is not as extensive as that in the first area. A few examples must suffice: Pierre Teilhard de Chardin, *Science and Christ* (New York: Harper & Row, 1968), and *Christianity and Evolution* (New York: Harcourt Brace Jovanovich, 1971); Karl Rahner, "Christology Within an Evolutionary View of the World," in *Theological Investigations* 5 (Baltimore: Helicon, 1966), 157-92; Gabriel Daly, *Creation and Redemption*, cited in note 65 above. On Teilhard's extensive efforts at reformulation, see my *Teilhard de Chardin and the Mystery of Christ* (New York: Harper & Row, 1966).

⁶⁹ Alfred North Whitehead, *Science and the Modern World* (New York: Free Press, 1967) 181.

constant need of adjustment at their points of overlap. For while we may no longer have two totally separate realms of discourse, we also have little likelihood of achieving a single integrated intellectual enterprise. A coherent vision of all things may indeed be the ultimate goal of the dialogue, but scientists as well as theologians will have to settle in the short run for a friendly collaborative sharing and scrutiny of their fallible insights into very different aspects of reality.

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